Volume 19 May, 1933 *Number 5*

Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

Brewery Machinery

The Lubrication Requirements

PUBLISHED BY
THE TEXAS COMPANY
TEXACO PETROLEUM PRODUCTS

WE ARE READY!

The art of brewing dates back to the ancients. Later it became a proprietary function of the monasteries. It is of interest to note that in those days beer served as the principal beverage at all meals. Even then its food value was realized.

Today our modern methods of brewing, sanitary control of the processes, and the enlistment of chemical research in the interest of improving this food value, indicate the good judgment of the medieval monks, who developed this art.

Their processes, we venture to say, caused but little concern, for they were manual. Today, however, these processes are mechanical and present numerous problems, notably the protection of lubrication; for dust and moisture must be reckoned with in the development of effective performance of lubricating oils and greases. This requires study of machinery construction, methods of lubrication, and the adaptability of certain types of lubricants to meet these conditions.

All this has been realized by The Texas Company in preparing themselves to service the equipment of the brewing industry.

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Change of Address: In reporting change of address kindly give both old and new addresses.

Brewery Machinery

The Lubrication Requirements

TO the majority of people who have followed the trend of current events, the recent act of our government in deciding once again to legalize the brewing and sale of beer, means nothing more than the setting in motion of a class of machinery that has been largely idle since the war. A simple matter to many who are accustomed casually to pass over engineering and manufacturing projects, as though they involved but the waving of a wand.

The brewmaster, however, is fully cognizant of the fact that rehabilitation of his industry is a huge problem, for a vast amount of his machinery has either become obsolete or incapable of efficient operation. Obviously all this must be corrected. For months plant operators have anticipated the return of their industry, just as machinery builders have intensified their efforts in studying such alterations in design as may be necessary to meet expected production requirements. This should be more clearly understood by the layman, for it entails far more than the throwing of a switch, and the turning of a few valves to start the mechanisms of the modern brewery. Lubrication must play its usual important part in this as in every other industry, if operations are to continue economically and effectively.

In the realization of this fact it is felt that the machinery of brewing should be carefully discussed, to the end that the lubrication requirements are clearly understood, and studiously observed in the selection of lubricants for a class of machinery which may be decidedly unique to many.

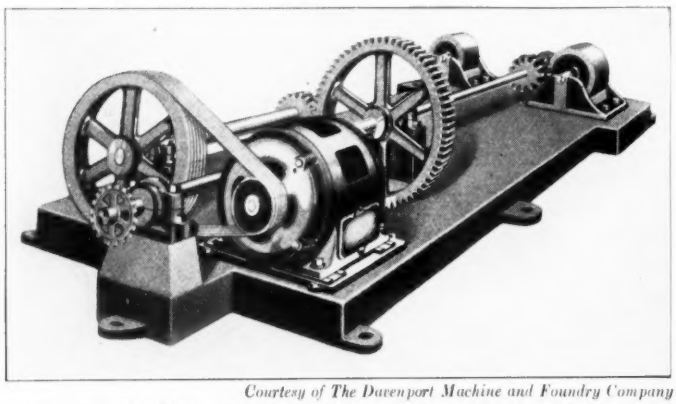
The several operations incident to the manufacture and handling of beer are carried on in the mill house, the brew house, the washing and racking plant and the bottling house. In addition, the power and refrigeration plants furnish the power, heat and refrigeration essential to the handling of the raw product, the operation of machinery and cooling or removal of the heat developed during fermentation. In these several departments of the average brewery, conditions prevail which may present a distinct problem in maintaining lubrication of the essential machinery.

Dust a Factor in the Mill House

In the mill house dust is a factor which must always be considered by the lubricating engineer. Dust results from handling and crushing of the grains, which are used in preparation of the mash. This dust may become a decided hindrance to effective lubrication wherever conveying and elevating machinery mechanisms, which constitute the majority of equipment in the mill house, are exposed to its entry. Modern practice is to design bearings, chains and driving gears of this equipment in such a manner as to prevent entry of dust or other abrasive, non-lubricating foreign matter. This is not always practicable,

however, especially where plain bearings are involved, or where gears cannot be completely housed.

In deciding upon the type of lubrication which will be most effective, it is necessary to study the existing design and construction of all parts requiring lubrication, for minor alterations, or judicious choice of lubricants may often forestall development of aggravating difficulties later on. In the case of plain bearings, for example, where provisions are made for oil cup lubrication, the substitution of grease of proper consistency may be highly advisable. Oil, in any plain bearing, unless this latter is of the ring, chain or collar variety, will tend to work out along the shaft as the latter rotates. In doing this, it of course maintains lubrication, but frequently it cannot seal the exposed ends of the bearing against penetration of dust into the clearance space. Furthermore, the resultant dripping is always objectionable, and often a hazard. Grease, on the other hand, if applied by compression cup or pressure gun, develops a collar or seal at these exposed bearing ends effectively to prevent entry of foreign matter. The only precaution is to select a grease of a sufficient body or consistency to prevent dripping, and to apply it carefully to avoid waste. For average conveyor mechanisms a high grade of medium bodied grease should serve the purpose.



Courtesy of The Davenport Machine and Foundry Company

Fig. 1—Showing driving mechanism and under carriage at the feed end of a Davenport rotary dryer used for drying wet grains. Note in particular methods of drive and relative location of reduction gears. Rollers at discharge end are equipped with Timken roller bearings, provided for grease lubrication.

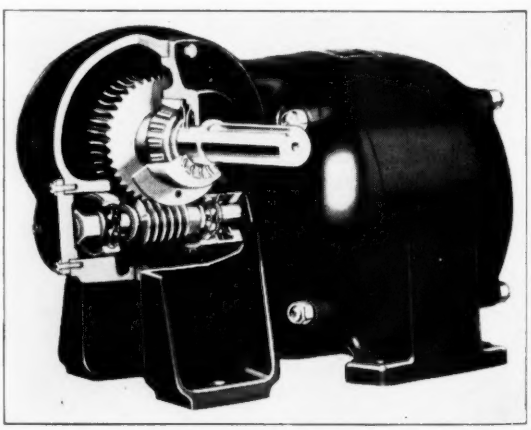
The advent of the anti-friction bearing has been a welcome development to the conveyor engineer, for it has enabled design and construction of bearing housings which can be readily sealed against entry of dust. Both ball and roller bearings have been applied to such mechanisms. Grease is widely preferred for the lubrication of such bearings. In the brewery mill house a medium consistency product capable of handling in the average hand or power type pressure gun should meet all requirements. Care must be taken in lubricating any anti-friction bearing, however, for over-charging with grease may cause unnecessary power consumption, due to the friction within the grease itself. This will be particularly true where greases containing oils of higher viscosity are used.

DRIVING MECHANISMS

The electric motor is the principal media whereby power is transmitted to the materials handling equipment in the modern brewery. The manner in which it may be connected to various conveyors, elevators, or crushing machinery, however, will vary. Group driving from a common source of power transmission may prevail in some breweries. Others will have regarded individual drive through gearing, chain, belt or tex-rope connections as most practicable. From a lubrication viewpoint gearing will probably be of the most interest, although the silent chain should also be discussed.

The Geared Motor

The adaptability of the geared motor to individual drives where extensive speed reductions are necessary, is particularly noteworthy. Indications are that it will receive careful study in rehabilitation of mill house equipment as a medium for operating the agitating elements in mash tubs. To date these elements have been driven either from above or below. The under-drive method is preferable, due to elimination of possible contamination of the vat contents by lubri-

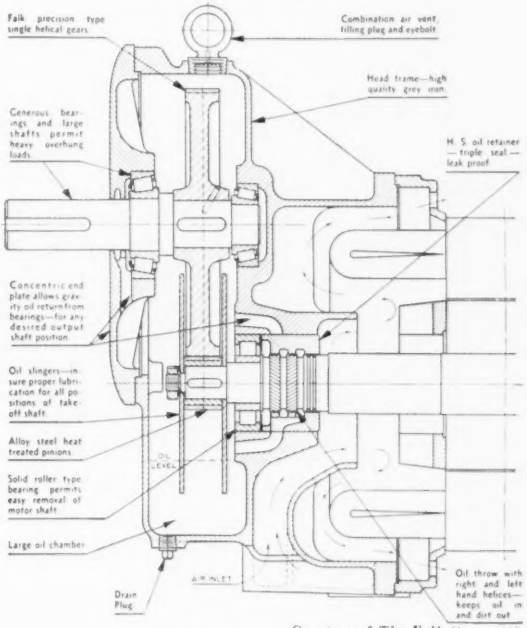


Courtesy of The Lamson Company, Incorporated

Fig. 2—Showing details of the Lamson geared head motor, wherein reducing elements and motor are combined. Note use of ball bearings on worm shaft and roller bearings carrying the gear.

cants. It is most important to prevent such contamination, for presence of oil is a distinct detriment to the taste as well as the foam-keeping quality of the finished beer. For this reason, some brewmasters prefer to lubricate the agitator shaft bearings in top-driven installations with tallow.

The geared motor, however, is adaptable to either type of drive. By virtue of its enclosed and self-lubricating construction, leakage of lubricants is virtually eliminated. Bearings are, of course, no different than the bearings of any modern type of plain motor, being largely of the anti-friction type, designed normally for grease lubrication. For such elements a highly refined specially compounded grease of medium consistency will be suitable. The reduction gear set, however, is designed for oil lubrication, the oil being contained in a bath at a sufficient level to insure proper dipping of the lower gear teeth. As a general rule it is advisable to keep the oil bath at from one-third to one-half full, so that the bottom gears will be about half submerged. For such gearing an oil of from 500 to 900 seconds Saybolt viscosity at 100 degrees Fahr. will be suitable, according to the prevailing motor temperatures and the extent to which heat is transmitted to the gear case.

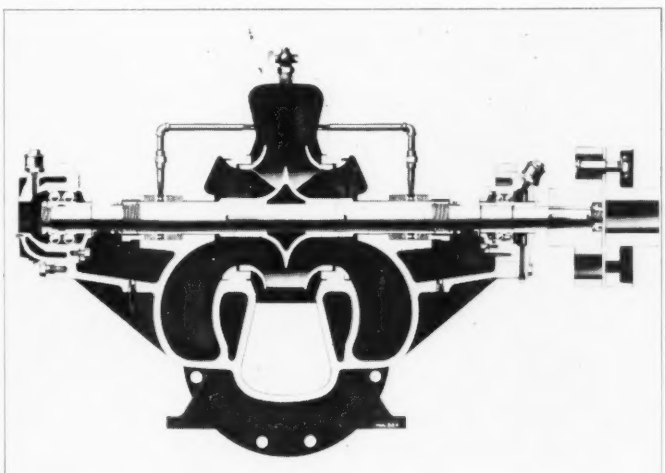


Courtesy of The Falk Corporation

Fig. 4—Showing details of the Falk geared-head Motoreducer. Note that provision is made for oil lubrication of both gears and roller bearings. By use of suitable oil retainers, entry of dirt or leakage of lubricant at the motor end is prevented.

Independent Reduction Gears

Where reduction gears are located in an independent housing or built as a separate unit from their driving element, the method of lubrication will depend largely upon the design of the gears and manner of housing. In many older installations the driving gears attached to the stirring mechanisms in the mash tubs will be more or less exposed. Whenever they are located above the tubs there will be a marked tendency to refrain from lubrication in the interest of preventing possible oil contamination of the contents. Even their shaft bearings may suffer likewise unless suitable oil drip pans are installed. Properly designed gear housings, and ring oiled or anti-friction bearings will eliminate this possibility to a marked degree.



Courtesy of Worthington Pump and Machinery Corp.

Fig. 3—Detailed view of a Worthington single-stage volute centrifugal pump. Note provision for grease lubrication of the line and thrust bearings which are of the ball bearing type.

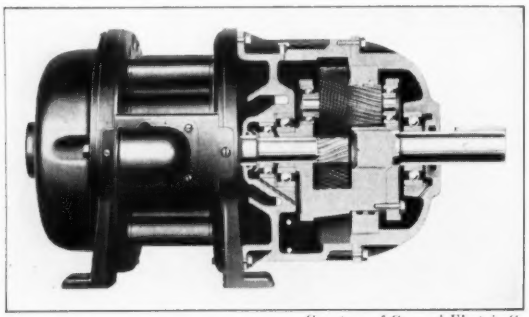
A variety of gear designs can be adapted to such service. In general, the chief proviso is marked reduction in speed. The bevel or worm drive is particularly adaptable. The latter requires careful consideration from a lubrication viewpoint.

The selection of the lubricant for such a drive should be based primarily upon the type of gear casing installed. In other words, an oil tight casing will enable the employment of bath lubrication and the use of a lubricant of just sufficient viscosity to preclude wearing of the teeth. Where but a safety gear shield or an open or leaky case is involved, naturally we must turn to the heavier grades of lubricants.

Worm Gear Requirements

Worm gear operation requires a lubricant

of comparatively heavy viscosity and sufficient adhesiveness to resist being wiped off the teeth when subjected to their combined sliding and rolling action. It must be remembered that in many installations the same lubricant must not only serve to lubricate the gears but also the worm shaft thrust bearings. Inasmuch as the lubricating requirements will differ considerably, in such cases it will be necessary to compromise and use a lubricant as suitable to both as possible. Usually a product of about the consistency of steam cylinder oil will meet the conditions.



Courtesy of General Electric Co.

Fig. 5—Showing cutaway view of a General Electric geared motor. The oil used in the gear housing should have the viscosity of a medium heavy motor oil. Note relative location of gears to driving element.

Bevel Gear Drives

Where mash tubs are equipped with bevel gear drives, if these latter are adequately enclosed in a suitable housing or base reservoir, it will enable the use of more fluid lubricants than sometimes used in a worm reduction gear installation.

In certain of such installations a straight mineral oil of about 750 seconds Saybolt viscosity at 100 degrees Fahr. will often suffice. In others the prevailing pressures and slow speeds require a heavier lubricant, capable of adhering tenaciously to gear and pinion teeth should be used. Here an oil having a viscosity of approximately 100 to 150 seconds Saybolt at 210 degrees Fahr. will be best.

Exposed Gearing

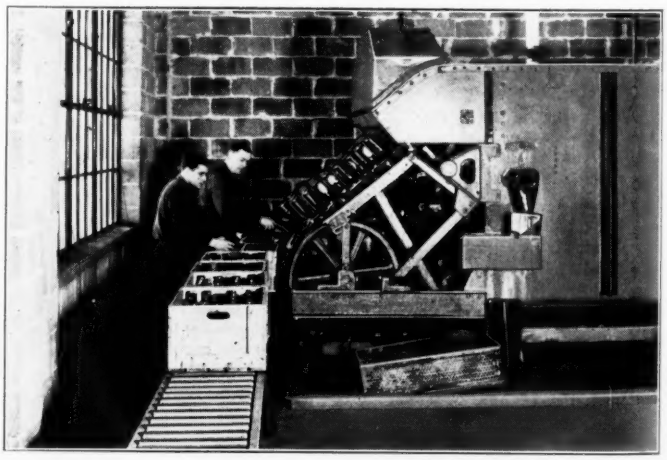
When gear drives are not enclosed in an oil-tight casing bath lubrication is usually precluded, and it becomes necessary to apply the lubricant by hand, in heated condition, by means of a brush. In such instances the lubricant must be of considerably higher viscosity than specified above, since it must maintain a suitable film on the teeth for a considerable period of time.

Low viscosity oils or non-adhesive greases will drip off when thinned down under the higher temperatures. For such gears it is therefore advisable to use a straight mineral gear lubricant of approximately 500 to 1000 seconds viscosity Saybolt at 210 degrees Fahr. Dirt and dust must also be considered when lubricating reduction gears of this type. Therefore, frequent attention should be given to cleaning the entire mechanism, otherwise excessive wear may occur due to the presence of abrasive material in the lubricating film on the teeth.

Anti-Friction Bearings

The extent to which the conveyor or elevator is used in some form or other in the modern brewery warrants thorough discussion of the improvements in bearing design which have taken place in recent years. Particular thought has been given to ball and roller bearings by many of the manufacturers in the interest of protecting the moving elements from contaminating foreign matter, and reducing power consumption.

From an external viewpoint, the average conveyor belies the importance of its bearings. Apparently it is able to function under a wide variety of intensive operating conditions, and frequently dust, dirt or abrasive metallic particles do not seem to affect its ability to operate; on the other hand, power consumption may be markedly increased. For this reason the bearings customarily used in conveyor service are among the most accurately designed parts in the field of materials handling. Particular effort has been devoted to devising means to prevent entry of non-lubricating abrasive matter. This has been an interesting development, for it has brought many heretofore skeptical operators to a realization of the



Courtesy of The Lamson Co., Inc.

Fig. 6—Showing a Lamson gravity conveyor carrying cases of empty bottles to a soaker or washer.

fact that lubrication can only be assured by continued maintenance of the lubricant in a proper state of purity.

Contrast of Operating Principles

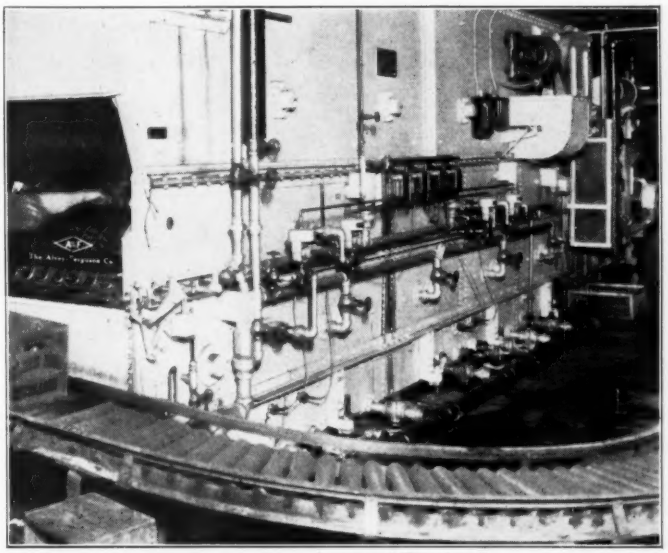
The anti-friction bearing is distinctive as compared with the plain or sleeve type bearing, in that from an operating viewpoint it will be very much more independent of lubrication. In other words, its ultimate efficiency will not depend to any marked degree upon its manner of lubrication for the function of the latter by means of either oil or grease is rather to protect the highly polished surfaces of the rolling elements than to serve as a means of reducing friction, carrying journal loads or removing heat from the bearing.

In the plain or sleeve type bearing, on the other hand, regardless of the means of lubrication or the lubricant used, the ultimate speed that can be developed and the load that can be carried will depend upon how effectively the lubricating system maintains an adequate film of oil in circulation through the clearance spaces to remove frictional heat and prevent metal-to-metal contact of the sliding surfaces.

Relation of Friction to Wear

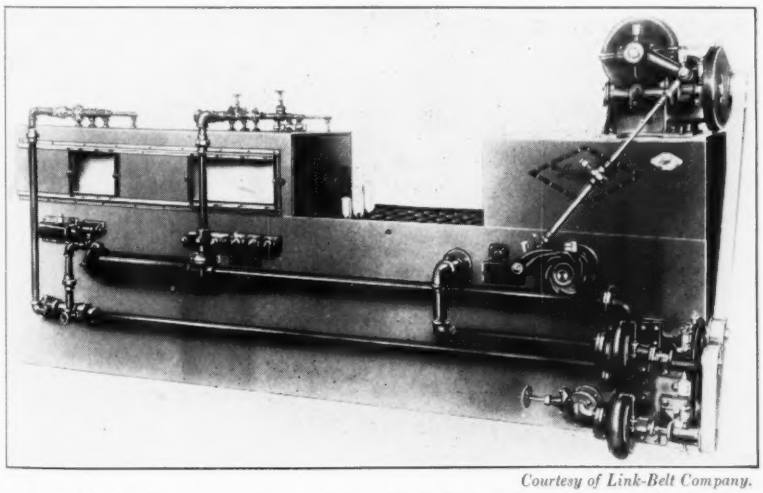
The fact that the anti-friction bearing, whether it be of the ball or roller type, will normally involve a minimum of friction, will be an asset in its favor wherever the occurrence of wear may be a detriment to productive efficiency and accuracy. Rolling motion will obviously not be prone to give rise to as much wear as will sliding motion.

On the other hand, rolling motion in an anti-friction bearing must be maintained as perfectly as possible, for if it ceases in the case of any particular element, as a ball or roller, more or less sliding will occur, to the detriment of the contact surfaces of itself as well as the raceways. To an extent this would approximate the operation of a plain bearing from the viewpoint of the type of friction developed, but with comparatively negligible means of counteracting this, for the prevailing lubricant would in all probability not be able to maintain an adequate load-bearing film or remove such frictional heat as would probably be developed.



Courtesy of The Alvey-Ferguson Company, Inc.

Fig. 8—Illustrating application of the Alvey-Ferguson type of conveyor to the brewery bottling plant. Bearings can be grease packed on assembly or lubricated periodically by pressure gun.



Courtesy of Link-Belt Company.

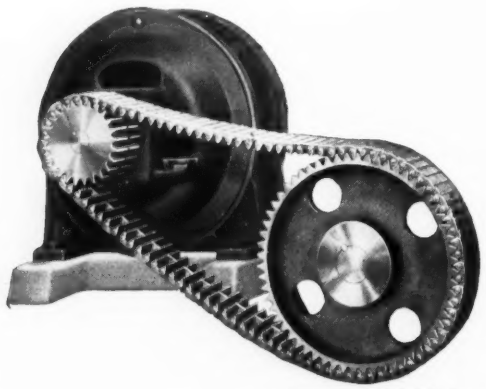
Fig. 7—Showing driving mechanism attached to a Liquid Carbonic Corporation soaker for cleansing bottles. Note lubricating attachments on bearing elements at upper and lower right.

Constructional Features

The modern anti-friction bearing will comprise a set of perfectly spherical balls or an arrangement of solid or flexible rollers. According to the nature of these elements they may be regarded as ball or roller bearings. In a discussion of lubrication, however, the collective term "anti-friction" bearing is preferred by many.

The essential difference between any particular makes of ball bearings will be in the design

of the housing. In the roller bearing, however, the design of the roller will be the chief characteristic. In general, this will be either solid or flexible. The latter is always cylindrical in shape, the distance between the inner and



Courtesy of Link-Belt Company

Fig. 9—Showing Link-Belt silent chain drive attached to an electric motor.

outer raceways being uniform throughout the length of the roller. Solid rollers, on the other hand, may be either cylindrical or tapered according to the type or design.

Manner of Housing

Anti-friction bearings in general will be carried or housed in much the same manner, irrespective of the nature of the rolling elements, i.e., in suitable containers comprising raceways or cages. In a typical design the inner race will fit on the shaft or journal, the outer being held by the frame or other rigid part of the bearing.

Between these so-called raceways are located the balls or rollers. These are kept in their proper position with respect to the races and to each other by the separator, cage or retainer. Rotation of the shaft sets up a rotary motion between the rolling elements and the respective inner and outer surfaces of the raceways.

Ball bearings are claimed to involve less possibility of friction, due to the fact that there is little or no end thrust involved. As a result the lubricant in such bearings serves more nearly the purpose of acting as a seal and metal-protecting medium.

In view of this fact, and to reduce the possibility of the development of abnormal internal friction within the lubricant, it is generally advisable to pay careful attention to the level of the latter.

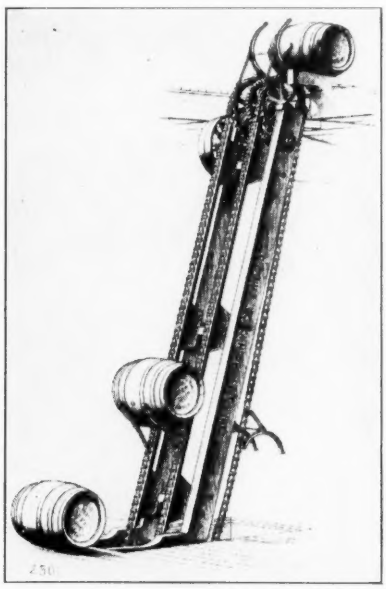
As a general rule, when oil is used the housing should be filled to a level sufficient to submerge approximately half of the lower-most ball. With grease, however, more lubricant must be used, the housing being from one-quarter to one-half full.

It is important to remember that contrary to the principles of plain bearing lubrication, the oil in a ball or roller bearing plays but a small part as a coolant. Therefore, volume, if excessive, may become a detriment due to internal friction within itself.

The selection of heavier lubricants for such bearings should be carried out with the utmost care, for it is very possible to over-estimate the conditions of operation, with the result that an excess of internal friction may be developed. As a rule, careful observation of bearing temperatures and cooperation with the builders and the oil industry will insure satisfactory results.

Grease as a Lubricant

Wherever there is possibility of oil leakage, or under conditions of dust, dirt or dampness, it may be advisable to resort to a grease as a lubricant. Greases furnish better seals against the entry of dust, dirt and moisture, thereby serving to protect the polished surfaces of the bearing elements in a very satisfactory manner. Grease can also be very much more effectively retained in a non-oil-tight housing; on the



Courtesy of Link-Belt Company

Fig. 10—Showing application of a chain type conveyor to a barrel elevator. Careful lubrication is important due to exposure of chain links and sprockets.

other hand, dirt or grit that finds its way into a grease lubricated bearing has no means of settling out, but is always held in suspension, being carried back into the bearing repeatedly.

To meet the requirements involved most

effectively, a grease for anti-friction bearing service should:

1. Show no tendency to separate oil in storage or when inactive within a bearing. Nor should this occur under moderate heating.
2. There must be no tendency toward hardening or decomposition.
3. There should be no constituent contained therein which might lead to corrosion, pitting or rusting of bearing elements.
4. Nor should there be any component which might tend to cause the lubricating film to become sticky or the grease itself to gum.
5. And, finally, the consistency involved should be suited to the operating requirements.

As a general rule, greases which are of comparatively average consistency will meet normal operating conditions where the lubricant must readily cover the entire surfaces of the balls or rollers and not tend to channel in the housings or raceways, as might occur with heavier products which would have less of a penetrative ability.

Flushing and Cleaning of Bearings

In order to insure the maximum of protection with any anti-friction bearing lubricant it is absolutely essential to keep the lubricating system as free from foreign matter as is consistently possible, according to the operating conditions and bearing construction.

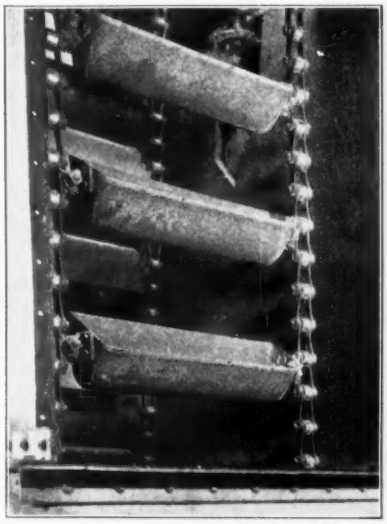
There is always possibility of entrance of impurities, especially where the bearing is not properly sealed. This is a matter of decided importance for we can realize that continued churning of abrasive foreign matter with oil or grease, in intimate contact with highly polished balls, rollers and raceways, may ultimately prove the ruination of the bearing and its respective elements.

In view of the fact that it is not always possible to effect the requisite degree of sealing, or to depend upon the seal being in good order at all times, lubricating systems should be flushed and cleaned at periodic intervals. The frequency will, of course, depend upon the design of the bearing, the type of seal, the lubricant used and the extent to which dust and dirt are present.

Chain Drives

Chain drives form an essential means of power transmission, both in the operation of certain types of mill-house equipment as well as in the bottling plant. By reason of the usual construction of the link mechanisms and the comparatively large number of moving parts, protection of these latter, by means of lubrication, to prevent abnormal wear is highly essential. Lubrication, furthermore, facilitates free bending or articulation, a most necessary property in any driving or conveyor chain.

The silent chain and the roller type construction are well suited to brewery equipment.



Courtesy of Link-Belt Company

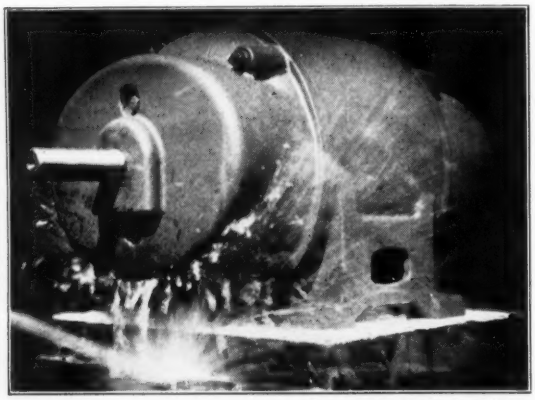
Fig. 11—Showing construction of chain and relative location of buckets on a Link-Belt bucket type elevator for handling malt.

Lubrication requirements of such chains can be best realized by study of the construction of the link mechanisms. In the silent chain this will involve a pin and bushing arrangement, or a form of rocker joint connection.

The term silent chain includes all such driving mechanisms as are built up of parallel series of links of such a contour as to enable them to cooperate with teeth cut in the sprockets so that the transmission of rotative power is positive. These links are fastened to each other and to the adjoining links by pins and bushings, or seat and rocker pins. The effect of construction of this nature is to give exceptional articulation or bending ability to the entire chain, with very little wear and noise, provided lubrication has been properly carried out. Due to the usual oil economy, which is obtainable on certain chains of this nature, and the possibility of reduced lubrication, little or none of the lubricant will normally be thrown off by centrifugal force, even under the higher speeds which are often prevalent. Cleanliness of operation is, therefore, also an advantage, especially on overhead installations where the chains and sprockets may be exposed.

Roller chains are used where a relatively inexpensive, heavy duty, durable chain is required, and where noise is not a serious objection. They are frequently applicable to service wherein a silent chain would be an

expensive refinement and yet they are designed and constructed to a high degree of accuracy, with their bearing surfaces machined to a smooth finish in order to enable effective lubrication, and insure against abnormal wear,



Courtesy of The Louis Allis Co.

Fig. 12—Showing a type of motor specifically designed to resist entry of water to the inner working elements. In certain brewery operations resistance to splash is distinctly advantageous.

particularly where higher speeds may be encountered.

Factors Governing Chain Lubrication

The attainment of dependable lubrication of driving or conveyor chains requires careful study of operating conditions. In fact only by combining a knowledge of such factors as speed, load, clearances and extent of bending or articulation can proper lubrication be determined upon.

Speed is important, since it involves the frequency of shocks due to engagement of the chain links with the gear or sprocket teeth. In other words, the greater the speed, the more frequent will be the shock on each link. Whether or not shocks of this nature will be detrimental to lubrication will depend upon the load and constancy of operation. It is natural to expect that rapid repetition of such shocks upon the bearing points of the chain may tend to force or squeeze the lubricating film out from between the rollers and bushings, or rocker bearing surfaces.

Bending or articulation of any chain will impose wear not only on the link pin bearings, but as well at the points of contact between the chain and the gear or sprocket. In fact, this is the chief cause of external wear, both of the chain, and sprocket, notwithstanding that correct chain design endeavors to eliminate, as far as possible, this tendency toward friction and external wear, confining necessary rubbing or rolling to the joints. Pins, bushings, rollers, etc., are therefore customarily built with adequate bearing surface to take up the usual strains. Still, a certain amount of external wear will be present at any event, and for this reason, an adaptable chain lubricant should be capable of effectively serving both internal and external wearing points.

Unfortunately, however, we are confronted with a situation where compromise is necessary. Depending upon the existing clearances, the lubricant must have adequate fluidity to enable penetration throughout the entire link, whether pins and bushings, rollers or rocker joints are involved. On the other hand, to prevent external wear of teeth and chain, a sufficiently heavy lubricant should be used to withstand shocks and resist the effects of centrifugal force. This requires compromise whereby sufficient viscosity reduction is obtained to meet one purpose, yet with the retention of adhesion as much as possible. Certain steam cylinder stocks, or reduced petroleum residuums have been proved to be excellent bases for such a type of lubricant, being blended where necessary with lighter, straight mineral products to give the desired viscosity according to the type of chain and means of lubrication.

On chains of the roller type the lubricant can be brushed uniformly over the wearing surfaces while they are operating slowly. Silent chains, however, may be bath lubricated, depending upon whether they are operated exposed or in an oil-tight casing. The speed of operation is oftentimes regarded as a guide as to whether a casing should be used. However, on drives where dust, grit or other foreign matter is present, as in the brewery mill house, a casing is always advisable, whatever the speed. Naturally, a chain which operates in a dust-proof, oil-tight casing, which is equipped with some form of automatic lubrication, will require the least attention, and operate most efficiently.

An effective type of casing chain-lubricator makes use of the principles of splash lubrication, by means of a disc attached to one side of the main shaft. As the wheel rotates the disc dips into the oil in the base, and throws it to the top of the casing, which is built in the shape of a wedge. As a result, there is a continuous and uniform dripping of oil upon the chain. In casings of this type, the oil level is below the chain, the disc dipping in it to a depth of somewhat less than one inch. Where bath lubrication prevails, however, the oil level should be somewhat above the lowest part of the chain. Casings which are used on high speed chains, in turn, are often equipped with an oil pump. Pressure lubrication is thus attained, the oil being sprayed continually upon the chain.

Where silent chains are operated exposed,

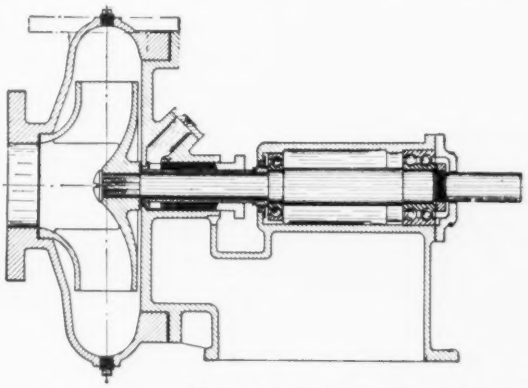
the lubricant must be applied either by brushing uniformly over the driving surfaces, or by removal and immersion of the entire chain. Certain manufacturers of chains of this type treat them with the lubricant before they leave the factory. Usually a soaking bath is used, the chains being immersed for a sufficient length of time to allow penetration to all interior parts. Such a treatment is regarded as insuring efficient lubrication over at least a month of normal operation, if dust conditions are not excessive. Subsequent soaking of the chain in the lubricant at periodic intervals is advisable wherever possible. When it is impracticable to remove a silent chain for such treatment, the bearing or driving surfaces should be brushed with a light, uniform coating of lubricant about once a week, or more frequently if necessary. If this is done during slow operation, satisfactory penetration will occur to all the joints through the combined effects of bending and capillary action.

By reason of the small clearances in silent chains, it is generally advisable to use a relatively fluid straight mineral lubricant. When chains are encased, if they are to be bath lubricated, an engine oil having a viscosity of about 500 seconds Saybolt at 100 degrees Fahr. will be suitable. Where exposed, or encased but not submerged in oil, a heavier lubricant, such as a mineral cylinder oil or light gear compound should be used. This product should also be suitable for roller type chains.

Considerable difference of opinion often arises as to the use of greases or other semi-solid products. In many cases these would serve the purpose admirably, especially on such chains as have sufficient clearance to enable proper penetration. It can be appreciated, however, that the lubricant must have a certain ability to flow, for capillary action cannot always be depended upon to bring about suitable penetration to the interior wearing parts of the chain.

BREW HOUSE PUMPING MACHINERY

Pumps constitute an important item in the equipment of the modern brewery. In consequence, the trend in pump design, and the lubrication requirements of the accepted types must be carefully studied, the more so because lubricants may often be called upon to function in the presence of excess moisture, which might seriously impair their lubricating ability. In the opinion of authorities the small high-speed centrifugal or rotary type of pump is more adaptable to modern brewery practice than the larger more cumbersome reciprocating units, so familiar to boiler room operations. Unit control by electric power is more flexible and regarded by many as more economical. Certainly it is easier and less wasteful to lubricate the bearings of an electric motor and centrifugal pump than the steam cylinders and external mechanisms of the average reciprocating pump. The centrifugal pump is also an all-service machine, being capable of handling hot or cold water, wort of any temperature, brine or beer with equal efficiency.



Courtesy of American Steam Pump Company

Fig. 13—Showing bearing construction of the American Type WHM centrifugal pump adapted to handling mash or spent grain. The impeller and shaft rotate on ball bearings which run in a bath of light machine oil.

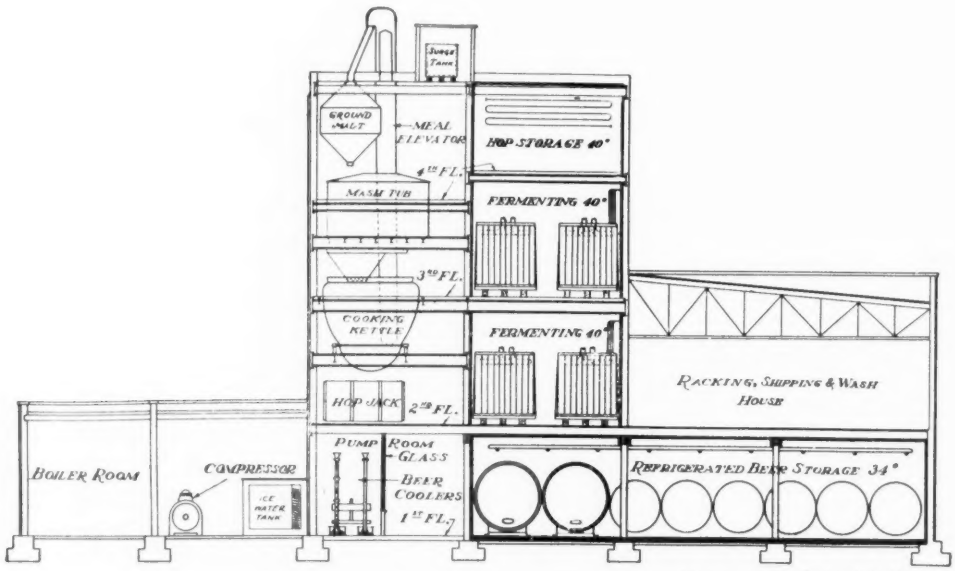
Where the steam-driven reciprocating pump still prevails, practice has indicated it to be suited to higher pumping heads, where gravity subsequently is made use of in flowing the wort. In such plants the wort pumps function largely as a means of carrying the wort to a higher level preparatory to cooling by allowing it to run down over suitable coolers.

Regardless of whether the wort is handled by gravity or pumps, beer in finishing can only be handled by pumps to the fermenting vats, the ageing tanks and then through the filters. At the same time similar pumps may be handling the hot water or brine, essential to preliminary manufacture of the wort or raw liquor, and subsequent cooling of this product or the beer itself in the course of treatment.

The fact that it is very necessary to prevent oil or grease contamination of the product at any stage of its manufacture, renders discussion of lubrication highly advisable. This should cover both the motive power and the design or construction of the moving or contact elements. Motive power will be derived from electricity in the centrifugal or rotary pump, and steam in the reciprocating type. Design, in turn, will include bearings, gears and steam cylinders.

Knowledge of the motive power is of importance only to the extent to which it may involve cylinder lubrication. The electric

motor as adapted to the centrifugal or rotary pump will only present additional bearings to be lubricated. Lubrication of the steam pump, on the other hand, presents the usual problems of steam cylinder lubrication, which will often be so in contrast to the requirements of



Courtesy of The Carbondale Machine Company.

Fig. 14—Longitudinal section of a typical brewery showing relative location of mash tubs, cooking kettles, hop storage, fermenting equipment and other machinery from a refrigerating point of view.

the other pump mechanisms as to involve considerable opportunity for faulty operation, if lubricants are switched or applied in a careless manner.

Reciprocating Pumps

Reciprocating piston and plunger pumps are extremely flexible in regard to speed, pumping capacity and head. They furthermore show a relatively uniform efficiency curve under wide variations in the above conditions. They are, therefore, adapted for heavy duty, or service under adverse conditions.

The operation of reciprocating pumps involves sliding friction between the essential operating parts. Broadly speaking, these will include pistons or plungers, valves, piston rods, valve stems, and the various external mechanisms that are required according to the type of drive installed.

Lubrication

For the lubrication of reciprocating steam pumps two basic types of lubricants are necessary, i.e., one to serve the internal parts such as steam cylinders and valves, the other to serve the external wearing mechanisms such as rocker bearings, guides and rod connections.

For steam cylinder lubrication the steam pressure is the salient factor, assuming 150 pounds pressure as the dividing line in the choice of oils. Saturated steam will predominate, so the discussion is based on this assumption. Above 150 pounds, for example, an oil of somewhat higher viscosity would be required than for lower pressure conditions. Too, a little less fixed or animal compound will be required due to the fact that there will probably be less moisture in the steam and less chance of washing action affecting the lubricating film once it is formed.

External bearing lubrication can be taken care of either by means of oil or grease according to the lubricating devices installed. In general plain babbitted bearings will predominate. Where oil is required a medium viscosity straight mineral product of from 200 to 300 seconds Saybolt at 100 deg. Fahr., will generally be satisfactory. For grease lubrication a medium consistency grease will be best in compression grease cups, although a somewhat more fluid product may be advisable for pin type cups.

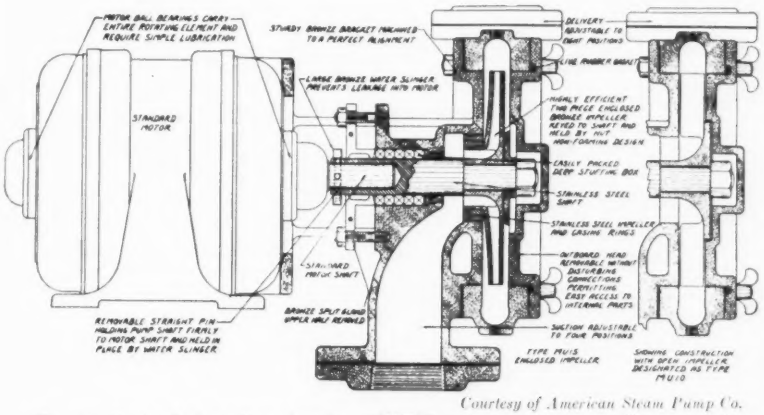
Centrifugal and Rotary Pumps

Of the several types of pistonless pumps which are used to transfer fluids by means of rotary motion, the centrifugal or rotary type are perhaps the most generally used in the brewery. The principle of rotary pumping such as is embodied in the screw pump, cycloidal, centrifugal, or other impeller device, etc., is

distinctive in that it involves no valves, springs, or other small parts to wear out and become inoperative. Furthermore, there are no internal parts which require lubrication.

Centrifugal Pumps

The centrifugal pump involves essentially one or more rotors or impellers, revolving in a fixed plane within a suitable air tight casing. The liquid is received at the hub or centre of the impeller, pressure being acquired as it is impelled outward to the circumference, via suitable blades. Dependent on the type, fixed discharge valves are used similar to stationary nozzles, or a suitably designed spiral casing is employed for discharge purposes. Volute pumps are of this latter type. In order for a centrifugal pump to attain maximum efficiency it must function free from air leaks, not only in the suction, but also in the pump; the discharge pipe must be of such a diameter as to insure the delivery of the liquid with a minimum of friction; the operating speed must be commensurate with the pumping head, and there should be a minimum of sharp bends and elbows in any piping involved.



Courtesy of American Steam Pump Co.

Fig. 15—Sectional view of an American "MUIS" sanitary beer pump. The entire element turns on the ball bearings of the motor. These latter are enclosed in housings with provisions for grease lubrication.

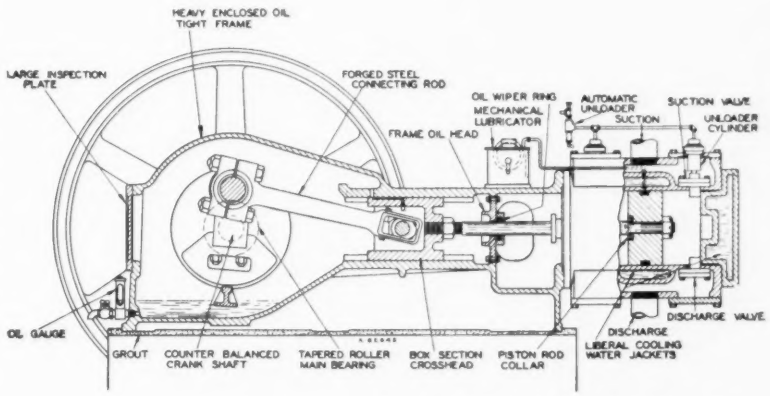
Rotary Pumps

Pumps with two rotating elements are commonly known as rotary devices, whether these elements are gears, screws, pistons, impellers, or cycloids. Essentially the principle is that of the geared pump, the matter of teeth or lobes being the criterion. With certain types such as the cycloidal for example, while the discharge is continuous it is not uniform, therefore air chambers are usually required on both the suction and discharge sides. These chambers act on the principle of the accumulator or fly wheel, absorbing any excess of product at the time of maximum flow to discharge it at the time of minimum flow thus insuring uniform velocity.

Lubrication

While pumps of this character will involve essentially the lubrication of bearings, these latter may vary in design and involve specific problems according to the operating conditions and the fluids being pumped. As a result, they require serious consideration and can not be passed over as mere instances of ring oilers, ball bearings, etc., or plain babbitted bearings served by oil or grease cups.

For general all-round service on horizontal pumps the ring oiler is preferred by many builders, due to its comparative simplicity, cleanliness, the extent to which it brings about automatic lubrication, the small amount of attention which it requires, its economy, and the uniformity and regularity of oil distribution.



Courtesy of Worthington Pump & Machinery Corp.

Fig. 16—Sectional assembly of a Worthington compressor. Note in particular mechanical lubricator for controlled cylinder lubrication and enclosed construction of crankcase. Main bearings are mounted on tapered roller bearings.

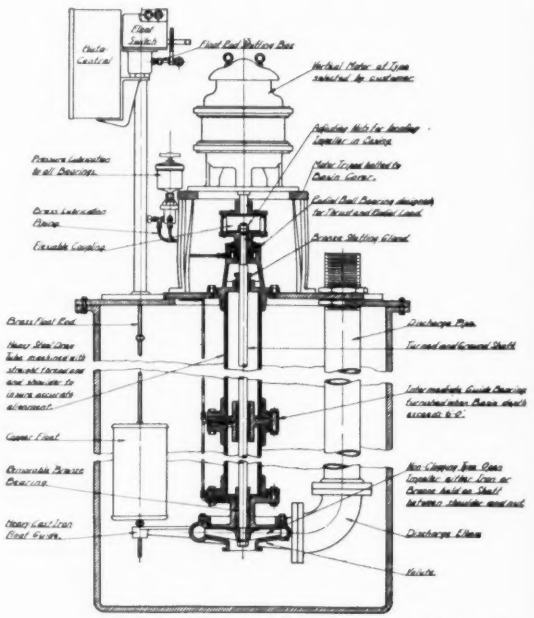
In construction the ring oiler comprises a bearing housing which is built with a reservoir and a slot of sufficient width and depth to permit one or more rings suspended from the shaft to revolve therein. As a result, with the revolution of the shaft, these rings being subjected to

rotation, will carry a certain amount of oil to the top of the shaft from whence it is able to flow into the bearing oil grooves and clearance space to be ultimately distributed to the entire wearing surface. As a rule, the oil after being passed through the bearing, will flow out to the end or ends of the shaft through a suitable return chamber which is part of the bearing housing, back to the oil reservoir below. Ring oilers, however, are not usually recommended for bearings below two inches in diameter, especially where high speeds are involved, due to occurrence of excessive slippage of the rings, and the possibility of foaming arising in the oil where reservoir capacities are limited.

Ring oiling is regarded by many as the simplest adaptation of the most efficient method of lubrication whereby the bearings are flooded with a considerable excess of oil over the amount that would theoretically be necessary to furnish the requisite oil film. By flooding the bearing with oil, the latter serves not only as a lubricant, but also as a cooling medium to carry away part of the frictional heat developed, thereby reducing the temperature of operation. If the oil reservoir in the base of the bearing has been properly designed and is of sufficient capacity, this overheated oil will have ample opportunity to become sufficiently cooled after each circulation by contact with the reservoir walls, particularly if the radiation of the latter is not interfered with. Lubricating systems of this nature possess natural advantages in that the flood of oil which is constantly passing through the bearings tends to wash out any grit, dirt, dust or metallic particles that may have gained entry, as a result, reducing wear to a minimum. On account of this washing action of the oil, however, the reservoir will gradually tend to accumulate a certain amount of sedimentary deposits. Therefore, it should be flushed out and cleaned at intervals, the old oil being replaced with new or purified oil. This is especially important when such a system is new and core sand, etc., may be present. In such cases several weekly changes are recommended.

It is evident that flood lubrication works on the opposite theory to that of supplying a bearing with just sufficient oil to furnish the necessary lubricating film. In fact, today in many types of machinery flood lubrication is the only method allowed by the builder. On the other hand, there are many arguments in favor of regulated lubrication such as embodied by the drip cup or automatic force-feed lubricator.

Ball or roller bearings are, however, preferred on certain of such types of pumps. They are advantageous in that they supplant sliding motion with rolling motion, thereby theoretically reducing the resultant friction where properly lubricated. Ball bearings involve point contact, whereas roller bearings involve line contact. In the lubrication of either type, however, one of the chief functions of the lubricant is to prevent corrosion of the highly



Courtesy of Economy Pumping Machinery Co.

Fig. 17—Typical cross section of an Economy type SSV sump pump adaptable to brewery operations. Note provision for pressure lubrication to all bearings and relative location of lubrication piping.

polished surfaces. As a result, wherever possible the housings should be oil-tight for thereby can we reduce the body of the lubricant and in consequence the internal friction that will be developed during operation.

Where leakage may develop, a grade of grease should be used which will have just enough body to cause it to remain in the bearing housing. Lubricating attachments may or may not be used on such bearings; irrespective of their use however it is necessary to charge or fill the housing and raceways periodically with the proper grade of lubricant, through a suitable orifice or fitting which can be effectively sealed or plugged during subsequent operation to prevent the lubricant from flowing out. In general, one charge of oil to a roller or ball bearing equipped with an oil-tight housing should last for a period of several months. Where grease is required, however, it should be renewed once a month or more often, according to the extent of seal which is maintained.

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